

REMARKS

Claims 1-18 are pending in the application and stand rejected. Claims 1 has been amended to incorporate the limitation of Claim 4, Claim 5 has been amended to incorporate the limitation of Claim 12, Claim 14 has been amended to incorporate the limitation of Claim 18, and Claims 4, 12 and 18 have been canceled. Reconsideration of the present application, as amended herein, is respectfully requested.

Claims 14-18 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite. The Examiner stated that the claim failed to point out that the hexose units are in the liquid crystalline solution, and suggested alternative wording. Applicant respectfully traverses this rejection.

Applicant respectfully suggests that the Examiner may have misunderstood the claimed invention. Applicant directs the Examiner to the exact wording of Claim 14. Claim 14 is directed to a solution which comprises a solvent and a polymer, the polymer comprising hexose units. There are no hexose units in the solution separate from those in the polymer. The claim further states that the amount of polymer in the solution is "an amount sufficient to form liquid crystals" and the resulting solution possesses "a solids content of at least 10%". Applicant believes that the claim is clear as written.

Claims 1-4 and Claims 14-18 were rejected under 35 U.S.C. 102(b) as being anticipated by Shibata et al. (US Patent No. 4,830,752), and Claims 5-13 were rejected under 35 U.S.C. 103(a) as being unpatentable over Shibata et al. (U.S. Patent No. 4,830,752). Applicant respectfully traverses these rejections.

The Examiner states that the Shibata patent discloses α -1,3-glucans, the degree of polymerization of the polysaccharides ranging from 5 to 500, that the glucan agents can be spun into fiber, and that the tensile strength of at least 1 gram per denier (gpd) is an inherent property of the α -1,3-glucans of the Shibata et al. patent since products of identical chemical composition cannot have mutually exclusive properties.

While the Applicant agrees with the Examiner that a composition and its properties can be inseparable, the Applicant also maintains that it is very well known in the art of fiber science that the tensile strength of a spun fiber of a given polymer will exhibit a wide range of properties depending upon the conditions of spinning. This concept is illustrated in the Examples and Comparative Examples of the present application.

In Comparative Example 1 of the present application, the same polymer employed in Example 6 was spun from a solution having less than 10% solids, a solution which was not liquid crystalline. The resulting fiber exhibited a tensile strength of 0.54 gpd versus 0.94 gpd for the fiber formed in Example 6. The solution in Comparative Example 1 was also described as "poorly fiber forming" and given its lesser tensile strength produced a fiber that

exhibited more fragility than the one produced in Example 6. Thus, tensile strength is not inherent in the polymer.

Applicant further points out that Shibata et al. merely mentions fibers in passing, providing neither description nor enablement, leaving one of ordinary skill in the art to ponder under what conditions the glucan polymer should be spun. As shown in the examples and comparative examples of the present application, such teaching is important to achieving a satisfactory result. Applicant submits that Shibata et al. is silent on how to make a fiber of the present invention and therefore, in addition to the reasons given above, Claims 1-4 are not taught by Shibata et al.

With regard to Synthesis Example 3 of Shibata et al., the Examiner states, without showing his calculation, that the solution of Shibata has a solids content of greater than 10% and will therefore exhibit the liquid crystalline properties of the present invention. Applicant respectfully disagrees.

Applicant does not understand how the Examiner performed his calculation but respectfully submits that it is in error. Applicant first notes that the term "solids content" as understood by one of ordinary skill in the art refers to the percent by weight of the solute. The following is Applicant's calculation:

$$\% \text{ solids} = \text{weight of polymer} / (\text{weight of polymer} + \text{weight of solvent})$$

$$\text{weight of solvent} = \text{volume of solvent} \times \text{specific gravity}^* \text{ of solvent}$$

*The specific gravity of organic liquids is available from widely available handbooks.

Thus, for Shibata et al.'s Synthesis Example 3, % solids is calculated as follows:

$$1.3 / (1.3 \text{ g} + 9 \text{ cc} (1.325 \text{ g/cc}) + 3 \text{ cc} (1.049 \text{ g/cc}) + 4 \text{ cc} (1.082 \text{ g/cc})) = 1.3 / 20.7 = 6.3\%$$

This solids level is well below the minimum critical solids concentration of 10% required for liquid crystalline order. Therefore, Applicant respectfully maintains that Claims 14-18 are not taught by Shibata et al.

Applicant maintains that the solution properties in Applicant's invention are in fact very surprising in the art, and there is no teaching or suggestion in the art of the liquid crystalline solutions of Applicant's invention, or of their being spun into high tenacity fibers.

It is known in the art that the polymers which tend to form liquid crystalline solutions are those which have a chemical structure which suggests a highly rigid extended chain morphology, namely those in which the polymer backbone bonds fall along a straight line.

Known examples of these are poly(paraphenylene terephthalamide) and cellulose. Cellulose, for example, is characterized by a $\beta(1\rightarrow4)$ linkage which imparts the linear structure. However, polymers in which the chain extending bonds are not parallel to the backbone in general do not form liquid crystalline solutions. Known examples of this are poly(metaphenylene isophthalamide) and starch. Starch is characterized by an $\alpha(1\rightarrow4)$ linkage, and does not form a liquid crystalline solution even at 25% solids, as shown in Comparative Example 4 of the present application. Even though the chain extending bonds of starch are on opposite sides of the hexose ring, the geometry at the carbon atoms containing those bonds gives rise to a chain conformation that is helical and not extended. Hence liquid crystalline behavior is not observed. Examination of the $\alpha(1\rightarrow3)$ linkage of the polymer of the present invention does not create the expectation that it will form a liquid crystalline solution, because it exhibits chain extending bonds that are not parallel to the backbone, but surprisingly, as reported in the present application, it does form a liquid crystalline structure. It is the property of forming a liquid crystalline solution that permits the preparation of spindope from which can be spun the fiber of the present invention which possesses a tenacity of at least 1 gram per denier. This is a major breakthrough in the art.

In view of the above, Applicant respectfully maintains that Claims 1-18 are not taught or suggested by the Shibata et al. patent.

In view of the foregoing, allowance of the above-referenced application is respectfully requested.

Respectfully submitted,



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